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Simulation of Future Land Use for Water Management

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Keywords: land use, spatial planning, spatial dynamics, water management

Abstract

Water management in the Netherlands is normally concerned with the prevention of flooding, but the opposite problem, water shortage, is increasingly getting attention. The idea of water shortage is not immediately combined with the wet appearance of the Netherlands. But there are indications for possible shortages of water at certain periods when the overall demand for water is high. Even in the wet Netherlands ground and surface water may become too scarce to allow for sustainable use for various functions as: transportation, irrigation, recreation and drinking water production. In order to assess the magnitude of this problem a water shortage study has been started in the Netherlands, in which the impact of land use change is an important issue.

Land use has a strong influence on the water balance of a given area. The relationship lies particularly in the fact that different kinds of land use allow for different levels of (rain) water to infiltrate into the ground. Especially the increasing urbanisation and changes in the agricultural areas greatly influence problems of water shortage. An increase in built-up area causes higher peaks in the drainage systems and less infiltration. Crop choice in combination with the soil type strongly influences evaporation and infiltration ratios. Also, the level of groundwater is determined often by land use. Land use models can help translate hypotheses regarding future spatial developments into maps of a possible future. These scenarios for the future can then be used in spatial planning processes.

Future land use is greatly influenced by current land use, autonomous socio-economic developments, current policy and in the long term climate changes and other changes in the physical environment. By using scenario's, hypotheses about developments in government policy, socio-economic factors, the climate and the physical environment can be combined. Various studies have already begun developing these scenarios, see for example ICIS (2002), Koole et al. (2001) en CPB (1996, 2001).

The main objective of this research is to examine the possibilities of using scenario analysis of future developments in a land use model as input for a water shortage study with RIZA instruments. In pursuing this objective, a secondary objective is to arrive at a fair translation of the relevant spatial developments for analysis. By combining existing future expectations into scenarios that are clearly different from each other, divergent images of the future can be generated for 2030. These scenarios will differ especially on the factors that influence the problem of water shortage. The extremes in future expectations will be pursued and not particularly the most probable scenario. In this way, a first impression can be developed for the bandwidth in which future developments can occur. The resulting land use maps will be used as input in specific hydrological instruments to assess the impact of land use change on water shortage. The predicted impact might lead to adjustment of current policies.

The simulations of future land use will be carried out using the information system Land Use Scanner. A detailed description of this model is included in Scholten et al. (2001). Important input for the simulation of land use are the different scenarios in which expectations with regard to the future are included. In designing these scenario's, it is important to determine both the location and the magnitude of the spatial developments. Furthermore, the Land Use Scanner will use maps of existing land use and distance decay functions in combination with attractivity maps for the various kinds of land use in order to calculate future land use in the various scenario's.

This paper will focus on:

- The composition of the scenarios;
- Their implementation in the land use model, and
- The results that were obtained.

Specific attention will be paid to the way these results can be used as input in other (hydrological) models to study the impact on water shortage. The conclusions of this paper will elaborate on the usefulness of this approach for supporting watermanagement in the Netherlands.

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